



**Intersolar 2014
Off-Grid Markets
ICM -Munich**

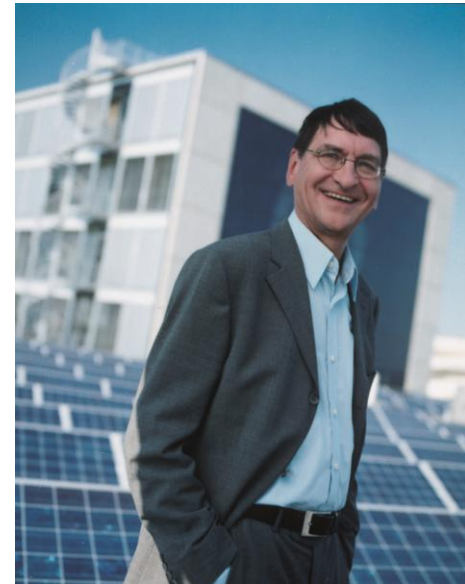
Global Market Potential for PV-based Mini-Grids in Developing Countries

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**inter
solar**
connecting solar business | **EUROPE**

RLI
REINER LEMOINE
INSTITUT

- **Renewable Energy Mobility**
 - Mobility concepts based on RE
- **Renewable Energy Technology**
 - Small wind power applications
 - Technical integration of RE
- **Renewable Energy Systems**
 - Optimization of energy systems
 - Energy transition processes
 - Off-grid energy systems



Reiner Lemoine
Initiation of the Reiner Lemoine-
Foundation and Institute

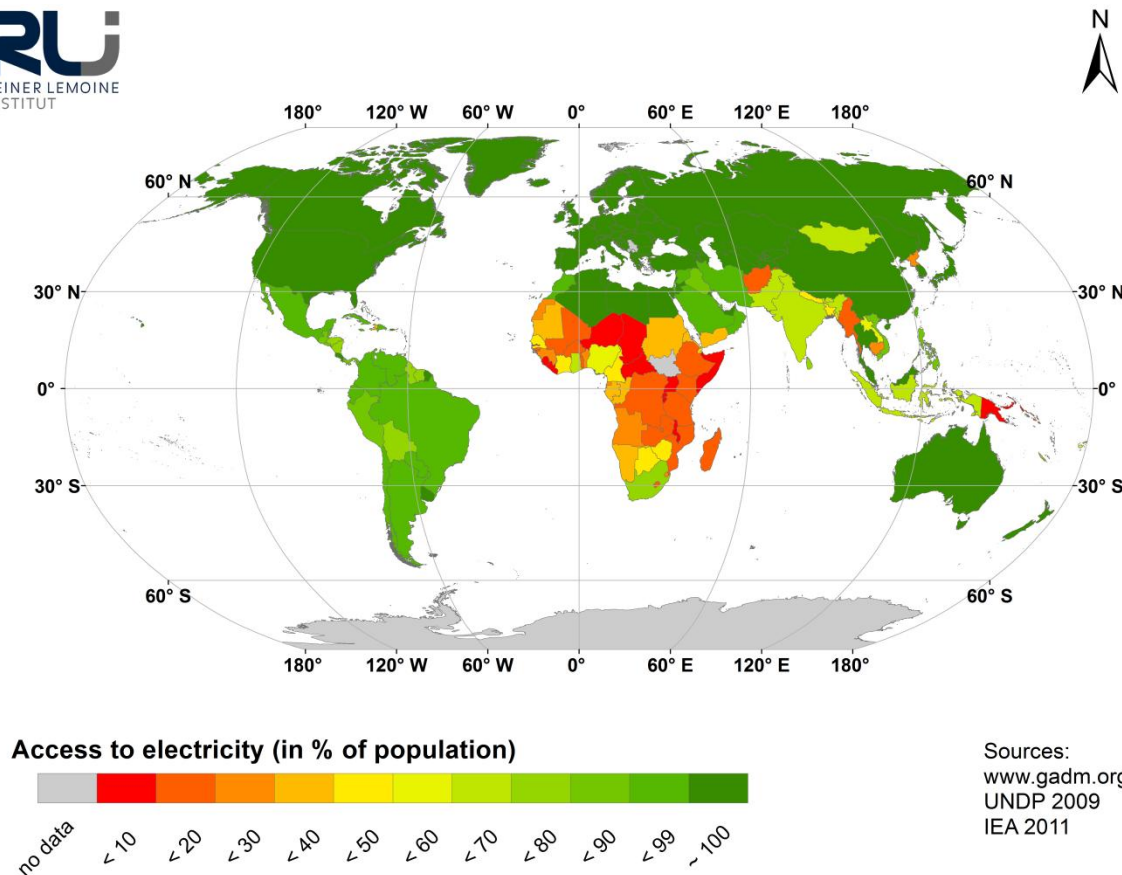
**Scientific research and support for a transition
towards 100 % renewable energies**

- **Simulation and optimization of renewable energy systems**
- **Analyses with geo-information systems (GIS)**
- **Resource assessment (solar, wind, hydro)**
- **Market potential analyses & feasibility studies**

Decentralized energy systems with high shares of renewable energies

Motivation

- 1,200 mn people without access to electricity
- Electricity access shares remain low although much effort is undertaken
- In some developing countries significant parts of GDP are spent on subsidizing electricity prices





Status Quo and Electrification Strategies

- **Access to electricity is a basic need and prerequisite for**
 - Education
 - Health care
 - Economic development
- **Different electrification approaches:**
 - Centralized approach:
 - Grid extension
 - Decentralized approach
 - Solar home systems
 - **Diesel generator**
 - **Hybrid systems (e.g. PV-battery-diesel)**

Fuel Price Trend/ Solar Price Trend

- Prices for crude oil have increased over the last years and are expected to do so in the future
- Costs for PV have been plummeting in the last years improving the economic feasibility additionally to its obvious ecological advantages

**High economic pressure on
existing electrification
schemes based on oil / diesel**

**Renewable energies become
an interesting option for
remote locations**

- **Upgrade of diesel grids with RE technology to reduce the dependency on fossil fuels and provide environmentally sound power supply**

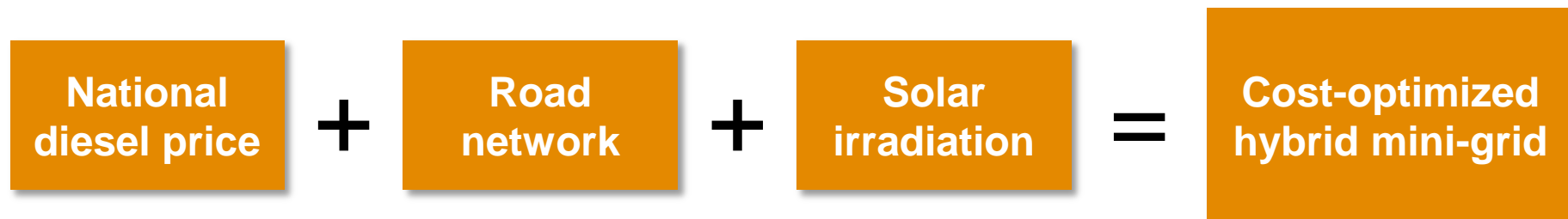
Geodata-Referenced Cost Analyses

Aim of the study:

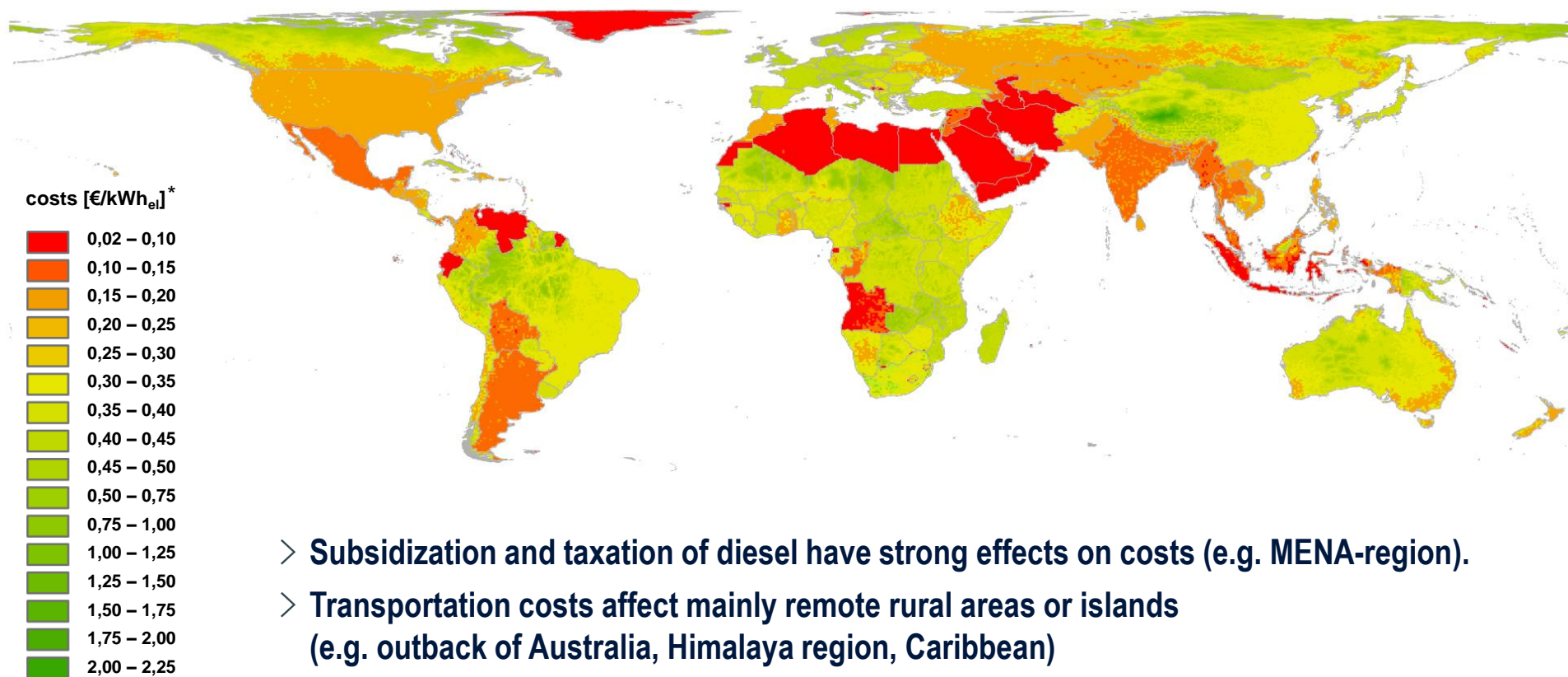
Quantify the potential for decentralized PV power by comparing the power generation costs of diesel only systems to PV based hybrid systems.

Research question:

Where are PV- diesel or PV-battery-diesel systems more cost effective than diesel only systems?

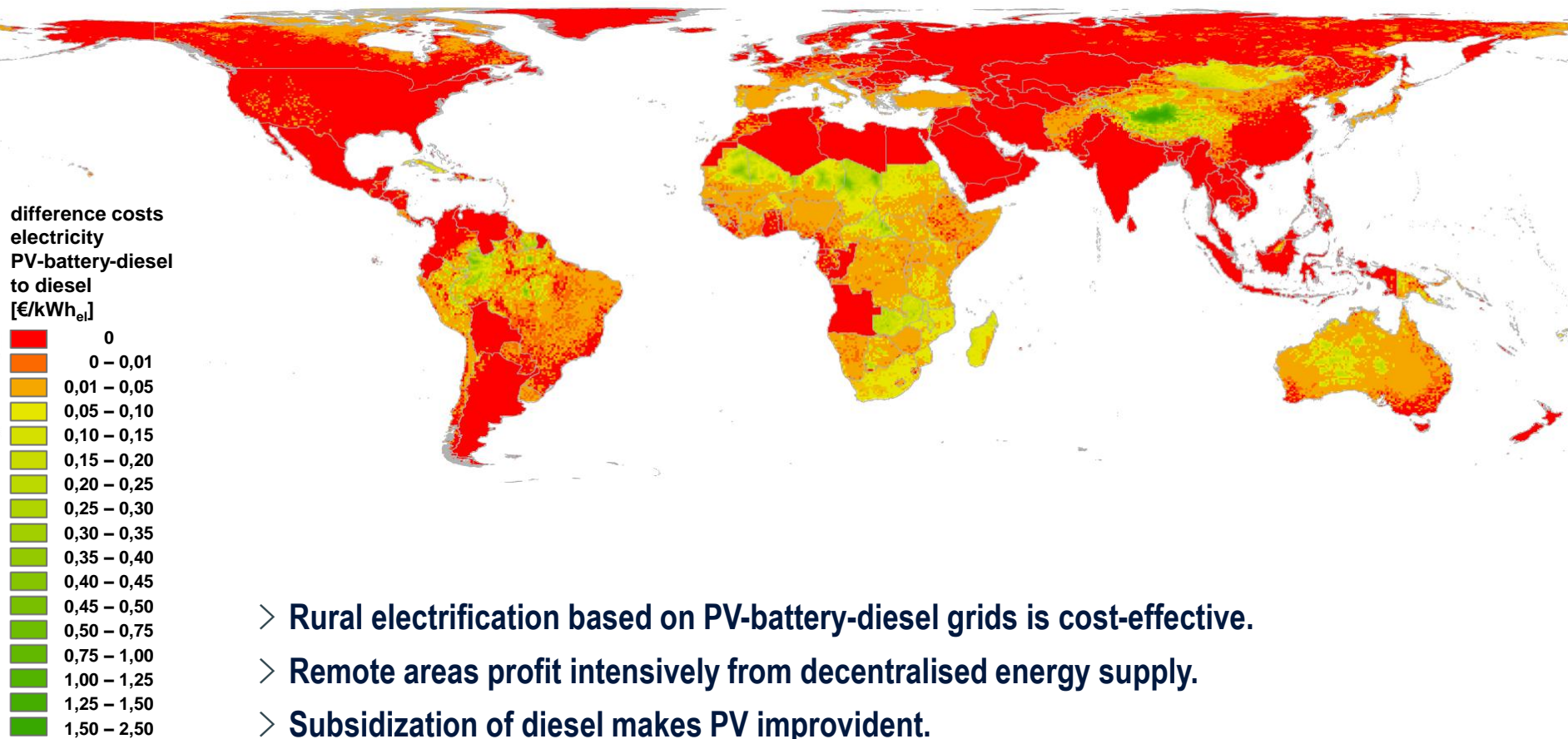


Local Diesel Power Generation Costs

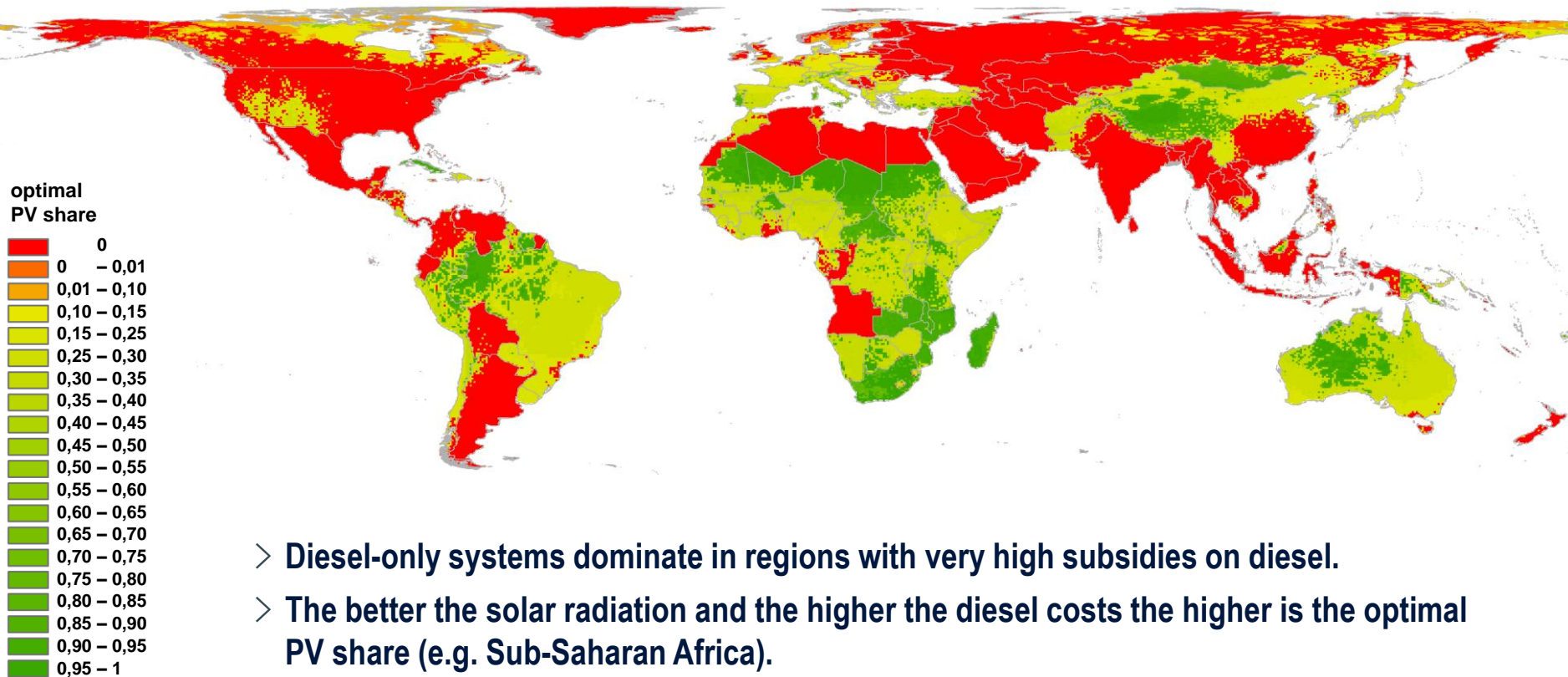


* 1 l diesel corresponds
to approx. 3 kWh_{el}

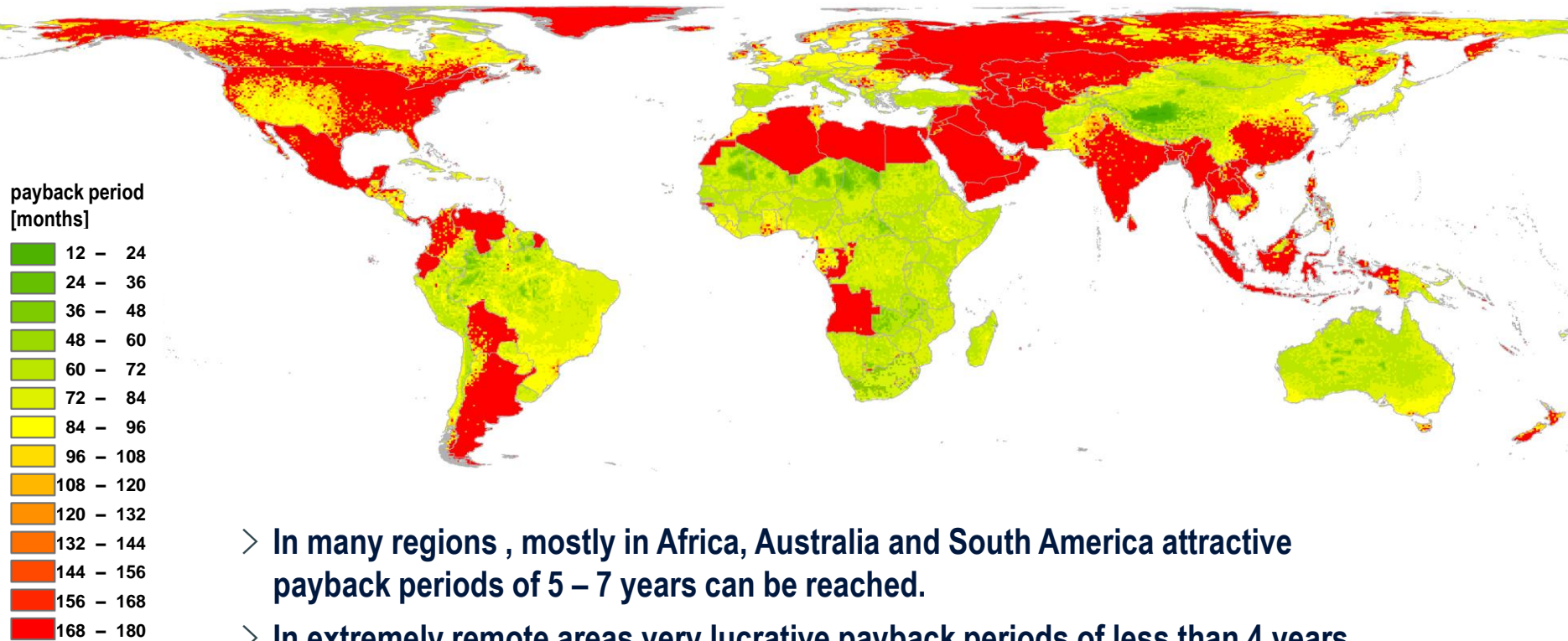
Cost advantage of hybrid systems vs. Diesel



Optimal PV Share of PV-Battery-Diesel System



Global: PV Mini-Grids Payback Period



- In many regions , mostly in Africa, Australia and South America attractive payback periods of 5 – 7 years can be reached.
- In extremely remote areas very lucrative payback periods of less than 4 years arise for PV Mini-Grids.

Comparative Country Ranking for Rural Electrification

Used criteria and weighting factors:





40 % **A: „Market potential“**

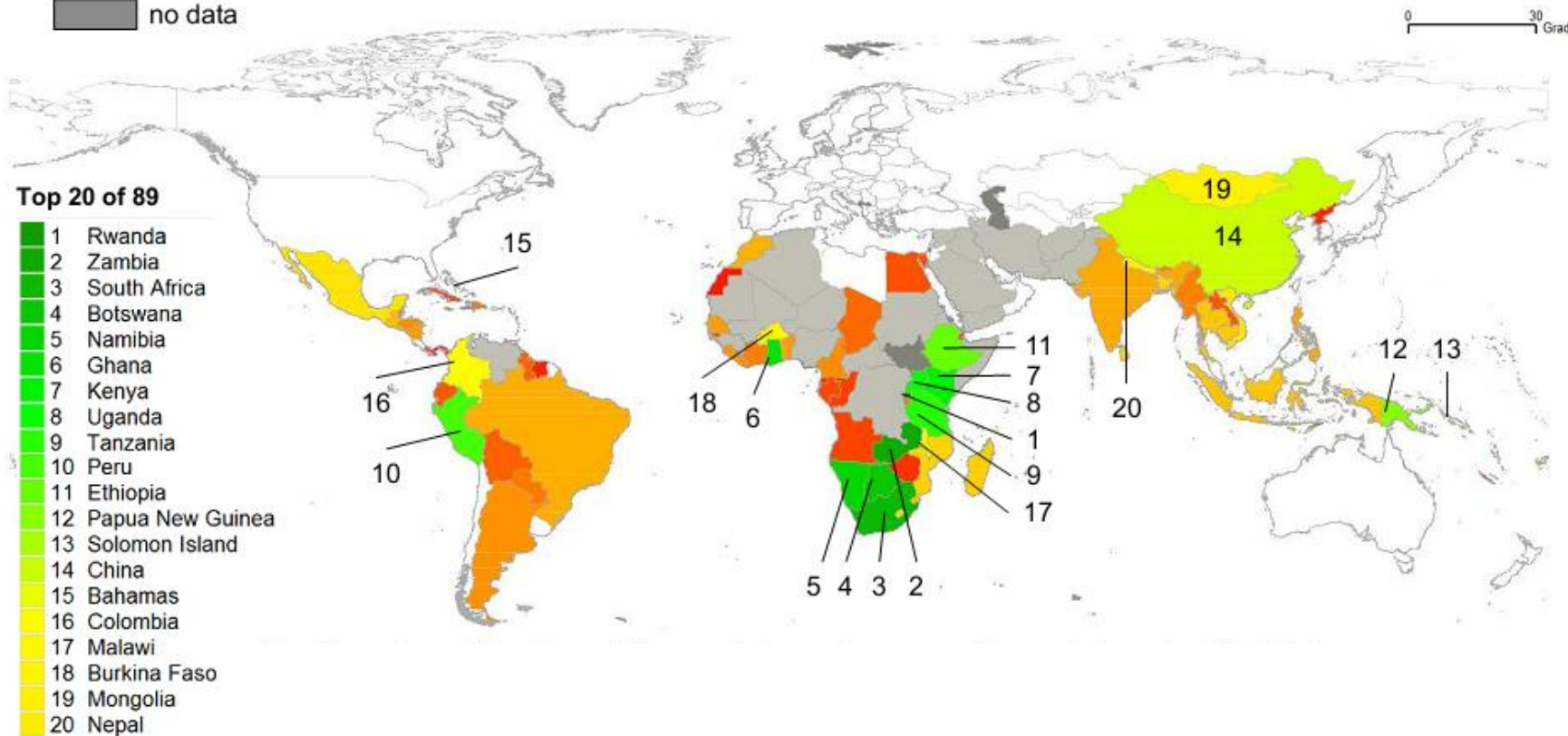
- 30 % • Electrification rate [worldbank, IEA, UNDP]
- 50 % • Rural population without access to electricity [calculated]
- 20 % • Dieselprice [worldbank]

60 % **B: „Political and financial framework“**

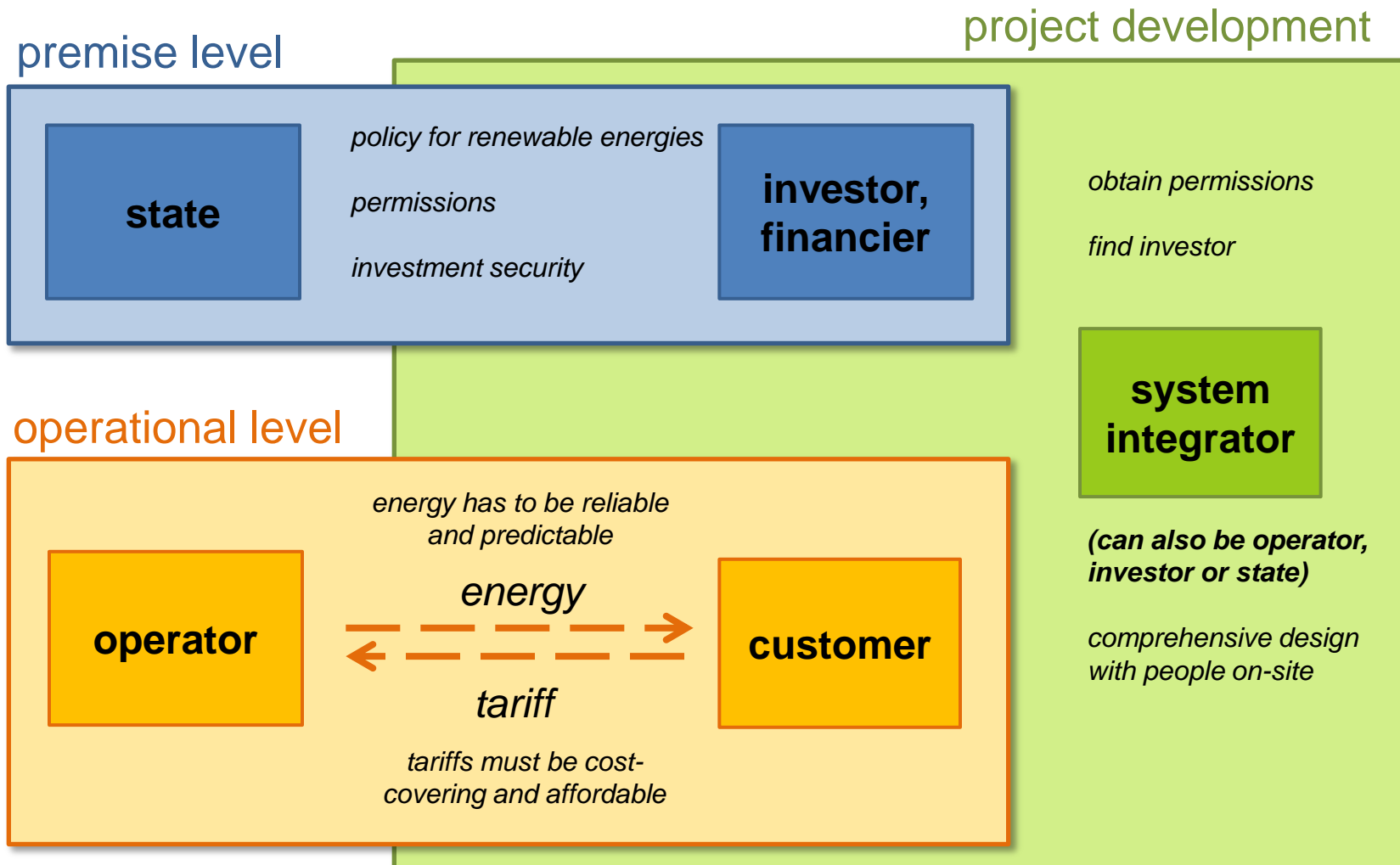
- 15 % • Political stability [worldbank]
- 20 % • Corruption index [transparency Int.]
- 15 % • Inflation rate [worldbank]
- 50 % • Ease of doing business index [worldbank]

Results of Comparative Country Ranking

-  exclusion criteria: political instability, travel warning from Ministry of Foreign Affairs, diesel price (≤ 0.25 USD/l)
-  not considered: electrification rate $> 95\%$ and $< 200,000$ people in rural areas without electricity
-  target countries: rank 1 to 89
-  no data



Levels and Participants of Electrification Projects



„Which specific electrification scheme is best for a given location?“

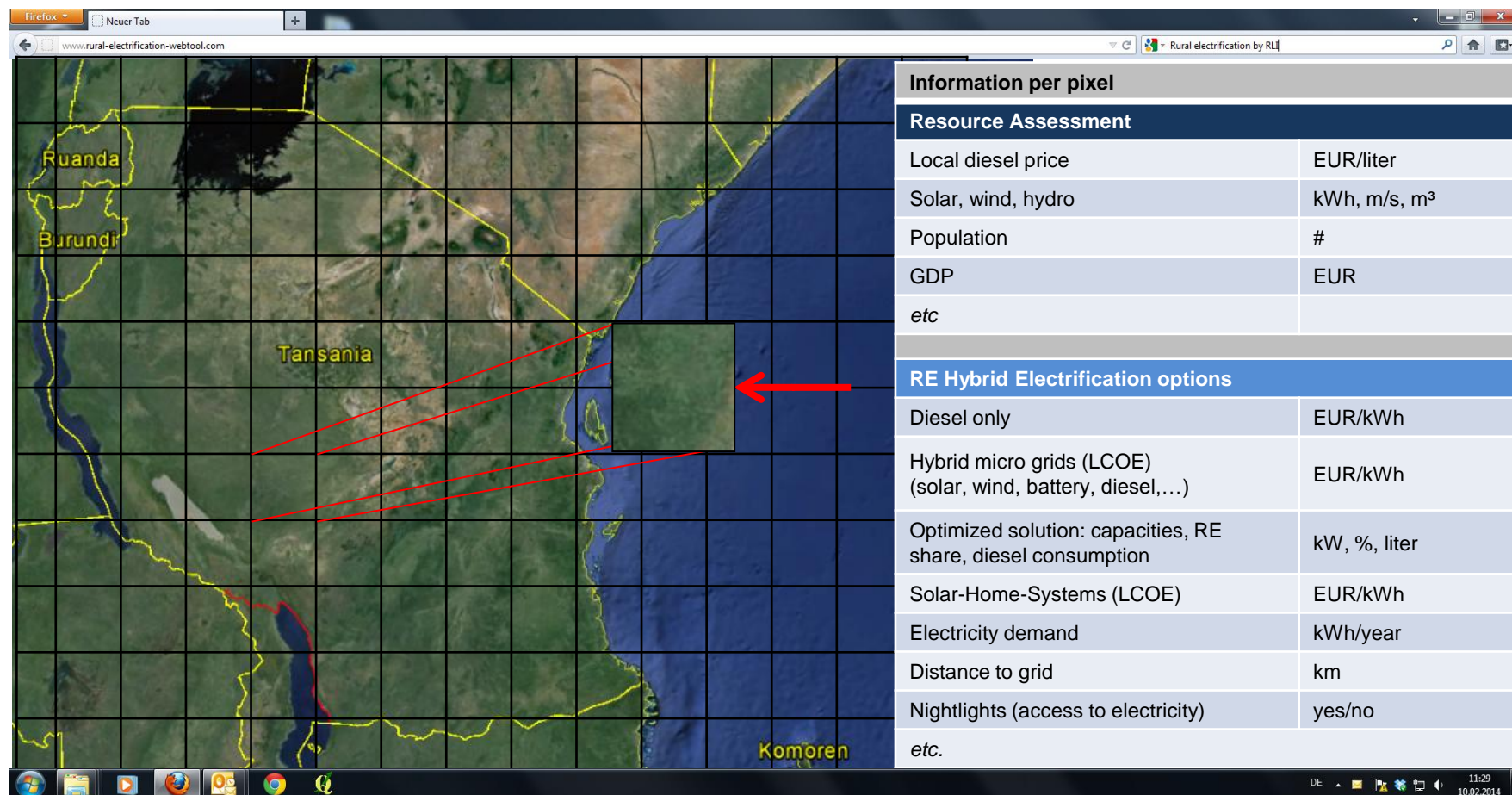
Planned joint research project of RLI and ARE:

„Off-Grid Solutions for Global Electrification“



Alliance for
Rural
Electrification
Shining a Light for Progress







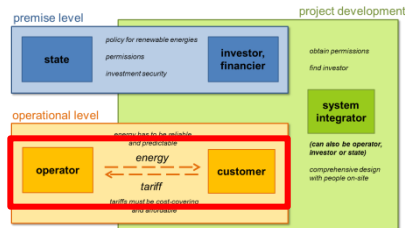
Thank you!



And special thanks to the RLI off-grid team

For further questions please contact us:

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requirements

- > has to agree to permit tariffs for mini-grids which are mostly higher than in the remaining country
- > has to create legal framework

frequent problems/experiences

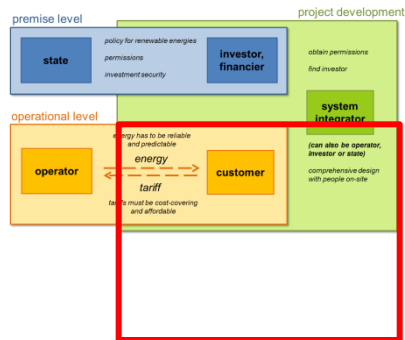
- > legal framework lacks
- > complex licensing procedures
- > scepticism about renewable energies
- > high import duties
- > monopoly on energy supply
- > financial sector is underdeveloped

requirements

- > investor has to take risks
- > financier has to be willing, to provide enough capital (for investor)

frequent problems/experiences

- > high investment costs at the beginning
- > foreign exchange risk
- > lack of credit availability
- > high transaction costs
- > insufficient trust in project development
- > lacking security during project period
- > local expactations on investment costs and return times

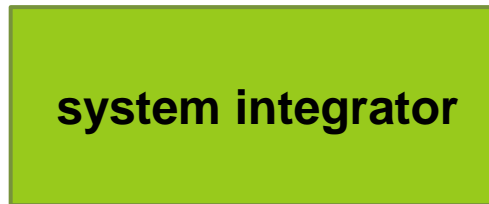


requirements

- > has to obtain permissions
- > has to find investor and financier
- > **currently has often firstly to create requirements**

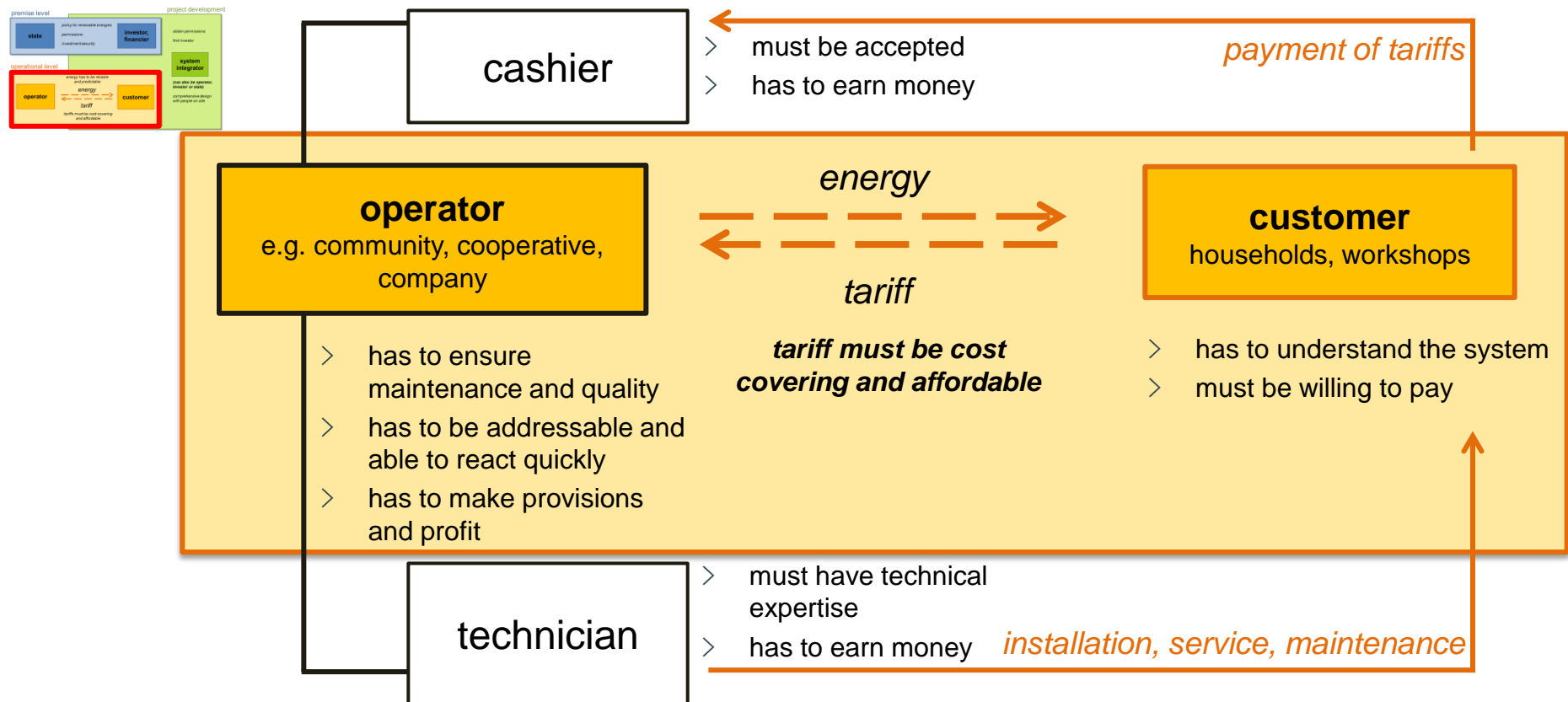
frequent problems/experiences

- > knowledge lack of local conditions
- > projects not adapted to local conditions
- > scarce communication with community and integration of local players



operation

- > has to meet cultural needs
- > has to plan for long-term operation
- > has to integrate and train local participants
- > has to create a sustainable tariff structure
- > has to ensure that responsibilities are clear defined



frequent problems/experiences

- > maintenance and responsibility for operation is neglected
- > continuous adaption with demand not considered
- > poor payment practices of consumers